Adoption and Utilization of Artificial Intelligence in Academic Libraries: Challenges and Opportunities in Developed and Developing Nations

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ABSTRACT

Despite the significant potential that artificial intelligence (AI) holds for transforming academic libraries, various challenges have hindered its widespread adoption and use. As a result, AI integration in academic libraries remains limited, particularly in developed and developing countries. There is a lack of comprehensive reviews that explore the challenges and opportunities of AI adoption in academic libraries from a global perspective, comparing experiences across different regions. Most existing studies focus on individual libraries, specific countries, or regions. This paper addresses that gap by examining the challenges and prospects of AI adoption in academic libraries in both developed and developing nations. Using desktop research and reviews of theoretical and empirical studies, 40 articles were analyzed, with 25 selected for the final evaluation. The paper identifies key barriers to AI adoption, including a lack of AI competencies and skills, limited knowledge and education on AI, resource constraints, ethical concerns, technological infrastructure gaps, fears of job loss, and the need for strategic planning. It also explores the potential benefits of AI in academic libraries, such as applying expert systems for cataloging, classification, and indexing, using virtual agents for reference services, and enhanced surveillance capabilities. While the adoption of AI in academic libraries faces numerous obstacles, the future remains promising. The paper recommends that libraries, governments, and other stakeholders must actively work to address these challenges, paving the way for successful AI integration in academic libraries across the globe.

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1. Introduction

Artificial intelligence (AI) has taken a leading role, dominating research and academic discussions. Its adoption has extended across numerous fields, professions, and countries. Notably, sectors like information technology, medicine, education, military, and business, along with nations such as the United States, the United Kingdom, the European Union, and China, are at the forefront of AI adoption. The benefits of AI are widely recognized, including enhanced efficiency, increased productivity, improved customer services, informed decision-making, personalized experiences, and reduced risks and errors (Owolabi et al., 2022; Oyetola et al., 2023). Academic libraries, though slower in adopting AI, are gradually catching up (Oladokun et al., 2023).

The idea of integrating AI into libraries has existed since at least 1985, but interest has surged in the last five years (Huang, Cox, & Cox, 2023). According to Li, Jiao, Zhang, and Xu (2019) in their report on the IFLA (International Federation of Library Associations and Institutions) 2017 Trend Report, AI's primary implications for libraries include speech recognition and machine translation for real-time multilingual support, complex identification of cloud services for web content, and next-generation browsers that go beyond simple keyword searches to incorporate semantic analysis. There is also significant potential for AI in academic libraries to improve user experiences, streamline operations, and enhance access to information in innovative ways (Nehra & Bansode, 2024).

Presently, numerous studies explore AI in academic libraries, focusing on AI-based services, benefits, and challenges (Aslim, Arif, Rafiq, & Ahmad, 2023), strategies for AI adoption (Huang, Cox, & Cox, 2023), and the readiness of academic libraries to integrate AI into operations and services (Ajani, Tella, Salawu, & Ajani, 2022). Studies also examine librarians' perceptions of AI technologies (Hervieux & Wheatley, 2021) and attitudes towards AI (Andrews, Ward, & Yoon, 2021). Outside academic libraries, AI studies cover user acceptance (Kelly, Kaye, & Oviedo-Trespalacios, 2023), AI use in universities (Moorehouse, Yeo, & Wan, 2023), AI competencies for organizational performance (Mikalef et al., 2023), AI in information systems research (Collins et al., 2023), the demand for AI skills in the labor market (Alekseeva et al., 2021), and integrating AI into organizational strategy (Barsha & Munshi, 2023; Borges et al., 2021), among others.

Artificial intelligence (AI) holds significant potential for industries, businesses, and libraries. However, both developed and developing nations face inherent challenges in adopting and applying AI in academic libraries. Consequently, a thorough investigation into these opportunities and challenges is necessary. The findings and baseline insights from this study can guide academic libraries in their efforts to adopt and implement AI technologies. Additionally, this analysis will provide valuable knowledge and data for governments, university administrations, library managers, practitioners, and AI developers to better understand the current state of AI adoption and use in academic libraries across different regions. The objectives of this study are to answer the following questions:

(1) What are the challenges inhibiting the adoption and use of artificial intelligence in academic libraries in developed and developing world?
(2) What are the prospects for the adoption and use of artificial intelligence in academic libraries in developed and developing countries?

2. Theoretical foundation

There are numerous theories related to the diffusion, gratification, implementation, and adoption of information and communication technology (ICT) systems. These frameworks have been widely employed by scholars to explain how technology spreads across societies and how individuals, organizations, and communities respond to its adoption. Among these, the Technology Acceptance Model (TAM), developed by Davis (1989), remains the most popular and frequently cited. TAM is designed to predict and explain individual behavioral intentions to accept or reject the use of information technology, with its core constructs being perceived usefulness and perceived ease of use. Due to its broad applicability and reliability, TAM has been validated and extended through various studies, resulting in several derivatives over time.

Other notable theories of behavioral intention include Fishbein and Ajzen's (1975) Theory of Reasoned Action (TRA), which links beliefs, attitudes, norms, intentions, and behaviors, as well as Ajzen's (1991) Theory of Planned Behavior, which emphasizes cognitive self-regulation. Venkatesh et al.'s (2003) Unified Theory of Acceptance and Use of Technology (UTAUT) also plays a key role in explaining user intentions toward ICT adoption, focusing on constructs such as performance expectancy, effort expectancy, social influence, and facilitating conditions. UTAUT is further moderated by variables like gender, age, experience, and voluntariness.

In terms of organizational and community adoption of technology, Roger's Diffusion of Innovation (DOI) Theory (1983) is one of the most widely used models. DOI explains how communication channels and opinion leaders influence the spread of new technologies and ideas at both individual and organizational levels. Other key theories include the Technology-Organization-Environment (TOE) framework by Tornatzky and Fleischer (1990), the Institutional Theory by Scott and Christensen (1996) and Scott (2001), as well as the model by Lacovou et al. (1995), among others.

Previous research has often combined these theories with other frameworks to better understand technology adoption in organizations. Given that artificial intelligence (AI) is being adopted across various professions, communities, and countries, it is clear that no single theory or model can comprehensively explain all the challenges and factors influencing AI adoption and use, particularly in both developed and developing nations. To address this complexity, this paper explores the challenges and prospects of AI adoption in academic libraries from multiple perspectives, incorporating insights from theory, practice, and scholarly discourse to provide a holistic understanding of the phenomenon.

3. Literature Review

3.1 The Concept Artificial Intelligence

Despite the growing scholarly interest in the adoption and use of AI across various fields, professions, and occupations, perspectives on its implementation still vary among academics, governments, and communities (Kelly, Kaye, & Oviedo-Trespalacios, 2023). As with many complex, interdisciplinary,

and multidimensional applied concepts, there is no universally accepted definition of "artificial intelligence." However, as Collins, Dennehy, Conboy, and Mikalef (2021) pointed out, this lack of consensus is not necessarily problematic. That said, efforts to provide a general definition of AI have been made by scholars and within reference works. For instance, the Online Dictionary of Library and Information Science (ODLIS) (2002) defines AI as "mechanical and electronic devices and applications designed to closely mimic the human ability to learn, reason, and make decisions," noting its use in voice recognition, expert systems, natural language processing, and robotics.

Since then, various scholars have attempted to clarify the concept of AI. For example, Kelly, Kaye, and Oviedo-Trespalacios (2023) proposed a synthesized definition in their systematic review on AI acceptance, describing it as "an unnatural object or entity that possesses the ability and capacity to meet or exceed the requirements of the task it is assigned when considering cultural and demographic circumstances."

The interpretation and application of AI in academic libraries, however, have only recently begun to gain attention. Kramer (2022), referencing Hervieux and Wheatley (2022) in their book *The Rise of AI: Implications and Applications of Artificial Intelligence in Academic Libraries*, defines AI as "the development of machines to accomplish tasks and reproduce thought processes that are normally seen in humans; this simulation of intelligent behavior is distinct from other forms of automation because it requires the computer to use human reasoning or thinking to perform tasks" (p. 70). Within the field of library and information science, Asemi and Asemi (2018) define AI as the use of computers and their associated products and services to perform various tasks and deliver services within libraries.

4. Methodology

This paper utilizes a content analysis methodology to investigate the challenges and prospects of artificial intelligence adoption in the study's focus area. First, a comprehensive review of relevant literature was conducted, targeting scholarly journals sourced from various reputable electronic databases, including ScienceDirect, Taylor and Francis, Scopus, and Web of Science. These databases were selected to ensure a broad and representative sample of high-quality studies on artificial intelligence adoption.

In this approach, key themes and patterns were identified by systematically coding and categorizing content across the selected articles. The reviewed literature, outlined in detail in Table 1, was assessed based on pre-defined criteria, which included publication relevance, scope, methodological rigor, and contribution to understanding both the challenges and future directions of AI adoption. This systematic content analysis enables an in-depth synthesis of existing knowledge, facilitating the identification of recurring themes, gaps in research, and emerging trends.

Table 1. Reviewed Published Articles

Author/s	Constructs	Study's Domain	Challenges
Aslim et al. (2023)	Application	Pakistan	Issues of High Network and Integrated Environment, Resources Restrictions, Talent Shortfalls
Huang et al. (2023)	Strategy	UK/China	Librarians Knowledge, Strategic Plan/Agenda, Technical Barriers, Lack of Funds and Professional Skills, Ethical Issues
Ajani et al. (2022)	Awareness/Readiness	Nigeria	Funding, Inadequate Experts, Limited Power Supply, Limited Budget, Personnel Training
Andrews et al. (2021)	Librarians' Intention	North America	Training, Education
Hervieux & Wheatley (2021)	Librarians' Perceptions	U.S.A. & Canada	Understanding, Education
Gujral, Shivarama, & Choukimath (2019)	Perception/Prospects	India	Privacy, Cost, Bias, Linguistic Style, Intellectual Freedom
Eiriemiokhale & Sulyman (2023)	Awareness/Perception	Nigeria	Internet Connectivity
Yakubu, Yagana, & Umar (2023)	Librarians' Intention	Nigeria	Non-Utilization
Lund & Wang (2023)	Impact	USA	Privacy & Bias
Subaveerapandiyan (2023)	Application/Impact	Zambia	Ethical Concern, Privacy Issues, Equitable Access to Information
Vijayakumar & Sheshadri (2019)	Application	India	Fear and Eagerness
Saldeen & Nawaz (2020)	Library Reference Service	Bahrain	Budgetary Issues, Expertise and Patron Preparedness
Kumar (2023)	Empowering Library System	India	Issues of Resources, Budgetary, Standardization
Akhtar & Shakil (2023)	Current Research on AI	Saudi Arabia	Bias, Job Loss, Declining Service Quality
Jha. (2023)	Prospects /Challenges	India	Adequate Funds, Librarians' Attitude, Technical Skills

The following keywords were used to search for relevant literature: "artificial intelligence," "academic libraries," "developed countries," "underdeveloped countries," "challenges," and "prospects." While no specific timeline was set for selecting the literature, the review includes both foundational and the most recent works in the field. Though the reviewed articles may appear to be concentrated in a few countries, this is not a cause for concern. Research has shown that these countries are among the top contributors to AI research in academic libraries (Hussain & Ahmad, 2023). Ethical considerations were carefully observed throughout the study, including respect for intellectual property, accurate attribution of sources, and adherence to copyright requirements. This systematic content analysis enables an in-depth synthesis of existing knowledge, facilitating the identification of recurring themes, gaps in research, and emerging trends.

5. Findings and Discussion

The findings and discussion are based on the objectives of the study and are presented thus:

5.1 AI Adoption and Use Challenges

The adoption and use of artificial intelligence in academic libraries, as well as in other types of libraries, is frequently regarded as inevitable. However, numerous challenges have made AI implementation highly complex, as highlighted by various scholars. A detailed review of published articles from both developed and developing nations reveals that the most significant challenges fall into the following categories:

5.2 AI Competencies and Related Skills

The adoption and use of artificial intelligence require highly specialized and skilled human capital. According to Alekseeva et al. (2021), the demand for AI-related skills has surged in recent years, particularly in the information sector. As key information hubs, academic libraries must develop AI competencies and relevant skills to effectively meet their core responsibilities in an AI-driven environment. One challenge identified in this review is the scarcity of librarians with the necessary AI skills and expertise. This issue extends beyond academic libraries. As Mikalef et al. (2023) point out, many employees across various organizations lack the requisite competencies for AI adoption and use. Specifically, the shortage of AI experts in academic libraries (Ajani et al., 2022; Saldeen & Nawaz, 2020) poses significant challenges for libraries in countries like Nigeria and Bahrain when adopting AI for library services and operations.

This issue of limited AI expertise has persisted in libraries for over three decades. Charles (1991) noted that a lack of AI experts in the library field and minimal training in AI techniques were major barriers to adoption.

While these studies focus on individual competencies, organizational AI competencies are equally important. Given that academic libraries cater to a diverse range of users, they can leverage AI technologies, such as natural language processing, to design personalized services based on user behavior and preferences (Huang et al., 2023). As Mikalef et al. (2023) argue, AI competencies can significantly enhance an organization's information management capabilities.

5.3 Knowledge/Education Effect

Knowledge and education are essential for fostering innovation within organizations, including academic libraries. However, the level of knowledge and education about artificial intelligence (AI) in these libraries is generally considered low, a challenge that has been reported worldwide. A study by Huang et al. (2023) involving the top 25 universities in the United Kingdom and Mainland China found that librarians' understanding of AI is a crucial factor in its adoption and use. Similarly, Hervieux and Wheatley (2021) highlighted that librarians in the USA and Canada recognize the

importance of investing in AI knowledge and education to ensure successful implementation in academic libraries.

In the UK, technical barriers related to AI adoption have also been observed, with Huang et al. (2023) noting a lack of technical support teams in libraries. This issue is echoed in studies from developing countries and North America, where researchers like Andrews et al. (2021) and Aslim et al. (2023) identified training gaps, limited knowledge, and talent shortages as major obstacles to AI adoption in academic libraries. To address these challenges, it is essential to improve AI knowledge and provide librarians with the necessary education to effectively operate in an AI-driven environment.

5.4 Resource Limitations

The adoption and use of artificial intelligence (AI) typically demand significant financial investment. The costs associated with AI technologies, along with the expenses for employee training and education, can be substantial. Alekseeva et al. (2021) note that organizations with substantial cash flow are more likely to invest in and adopt AI. However, academic libraries, as social institutions, often lack the financial resources needed for AI implementation.

Research in developing nations highlights several barriers to AI adoption in academic libraries, including resource limitations (Aslim et al., 2023), inadequate funding and restricted budgets (Kumar, 2023; Ajani et al., 2022; Saldeen & Nawaz, 2020), and high costs (Gujral, Shivarama, & Choukimath, 2019). These challenges have been observed in countries such as Pakistan, India, Nigeria, and Bahrain. Similarly, in developed nations, Huang et al. (2023) report that the financial overhead required for AI is one of the factors limiting academic libraries' engagement with AI in the UK and China.

Despite the high financial risk involved, adopting AI technologies could significantly improve academic library operations and services, aligning them with global trends and the vision of smart libraries for the future.

5.5 Ethical Principles and Practices

The ethical implications of artificial intelligence (AI) in the library profession are well documented. Core librarian values such as academic integrity, privacy, intellectual freedom, neutrality, and transparency face potential compromise through AI technologies (Huang et al., 2023). Additional ethical concerns include issues like plagiarism, cheating, and misinformation (Livberber & Ayvaz, 2023; Moorehouse, Yeo, & Wan, 2023). These concerns have, in many cases, hindered the full adoption and use of AI in academic libraries.

Ethical challenges have been reported in both developed and developing countries. In developed nations, studies by Huang et al. (2023) and Lund and Wang (2023) indicate that privacy and ethical issues significantly impact AI adoption in academic libraries in the UK, China, and the USA. Similarly, in developing nations, research by Subaveerapandiyan (2023) in Zambia and Gujral, Shivarama, and Choukimath (2019) in India shows that concerns over privacy and intellectual freedom are key barriers to AI adoption in academic libraries.

5.6 Other challenges

The challenges of adopting and using artificial intelligence (AI) in academic libraries are numerous and cannot be fully addressed in this brief discussion. The literature reviewed in this study highlights several obstacles that hinder AI implementation in academic libraries. A key challenge is the lack of technological infrastructure, including insufficient high-speed networks and integrated systems (Aslim et al., 2023), along with poor internet connectivity (Eiriemiokhale & Sulyman, 2023). These issues are particularly prevalent in developing countries, where internet access is limited, and many libraries do not have adequate broadband connectivity.

Additionally, the integration of AI into academic library systems is rare. Most libraries' current systems and services are not AI-compatible (Huang et al., 2023). Beyond technological barriers, concerns about job displacement also pose a significant hurdle. Librarians, like many other professionals, worry that AI might replace human roles within the library (Akhtar & Shakil, 2023), a concern echoed across various sectors (Alekseeva et al., 2021). Despite these fears, many believe AI has the potential to enhance library operations, creating new opportunities for librarians through roles in technical expertise, reskilling, and upskilling.

Another major barrier is the lack of a clear AI strategy. While this issue is not widely discussed in studies from developing countries, it has been subtly noted in research from developed nations. For instance, Huang et al. (2023) found that neither British nor Chinese universities have included AI in their strategic plans. The existence of such a roadmap in academic libraries from developing countries remains unclear. However, for AI to be successfully adopted in academic libraries, a strategic plan is essential. This plan should address libraries' attitudes toward AI, ensure sufficient funding and institutional support, and develop the technical skills of librarians (Huang et al., 2023).

5.7 AI Adoption Prospects

Artificial intelligence (AI) has significant potential to become a transformative tool in academic libraries, capable of enhancing user experiences and revolutionizing library operations (Subaveerapandiyan, 2023). Scholars from both developed and developing countries have highlighted the promise AI holds in this field. According to Huang et al. (2023), Hussain (2023), and Rudiansyah (2023), AI can make a substantial impact in areas such as expert systems, virtual assistance, automation, information searching, virtual reference services, and monitoring in libraries.

Expert systems in libraries, discussed by Huang et al. (2023), Jha (2023), Rudiansyah (2023), and Ehinomhen and Makinde (2022), are one key area where AI can bring significant benefits. These AI-based systems can automate tasks such as document classification, cataloguing, indexing, and abstracting (Huang et al., 2023). Rudiansyah (2023) provides examples of expert system software currently in use, including the Online Catalogue Library of Congress (OCLC) Automated Title Page Project for cataloguing, Canserach and MenUse for generating search statements in Medline, and Machine Aided Indexing (MIA) for indexing purposes. Other expert systems like COAL SORT, EP-X, and BIOSIS are used for classification tasks (Vijayakumar & Sheshadri, 2019).

AI-powered virtual assistance is another area where libraries can benefit, offering intelligent con-

sultation for tasks like searching, navigation, and reminders. One of the most common AI applications in academic libraries is the use of chatbots or virtual agents (VA), which rely on machine learning (ML) and natural language processing (NLP) (Huang et al., 2023). Platforms like MSN, WeChat, and others can be leveraged for this purpose.

AI also has the potential to enhance reference services, providing support for tasks like literature searches and answering directory-related questions (Rudiansyah, 2023). Moreover, AI is raising the standards for surveillance in academic libraries. As Fan and Shao (2019) cited in Huang et al. (2023) note, physical robots equipped with AI and Radio Frequency Identification (RFID) technology are being developed to autonomously pick, move, and inventory books and other materials without human intervention. In general, AI holds great promise for improving organizational performance in academic libraries. It has the potential to expand its applications to new products, markets, and services, while also monitoring and optimizing user experience, operational efficiency, and decision-making processes (Mikalef et al., 2023; Borges et al., 2021).

6. Conclusion

The study on the adoption and use of artificial intelligence (AI) in academic libraries across developed and developing nations presents a comprehensive understanding of the challenges and potential benefits AI brings to the field of librarianship. The findings indicate that while AI provides advantages such as enhancing cataloging, classification, virtual reference services, and user experience, numerous barriers hinder its full integration in both developed and developing nations. Key challenges include a lack of skilled professionals, insufficient funding, ethical and privacy concerns, limited technical infrastructure, and the fear of job displacement. These obstacles underscore the need for a structured approach to AI adoption, requiring collaboration between governments, academic institutions, and library management.

For academic libraries to effectively embrace AI, there must be a concerted effort to build both the technical and organizational capacity required to support such advanced technologies. Developing a robust policy framework is essential to guide AI integration in ways that respect ethical standards and address concerns about job security and data privacy. Furthermore, there is a pressing need for sustainable funding models to provide libraries with the financial resources needed to implement and maintain AI technologies. This investment will be particularly beneficial in developing nations, where funding limitations often restrict technology adoption and growth.

The study suggests that gradual, phased implementation of AI applications can help libraries navigate these challenges more effectively. By focusing on high-impact areas, such as virtual assistance and automated indexing, libraries can enhance user engagement and operational efficiency while testing the practical applications of AI on a smaller scale. Continuous professional development and strategic partnerships with AI developers are also critical to ensure librarians are equipped with the necessary skills and knowledge to drive successful AI adoption.

Finally, the future of AI in academic libraries remains promising yet complex. A balanced approach, incorporating ethical considerations, sustainable funding, and collaboration, is essential to overcoming

the current barriers and unlocking the full potential of AI in libraries worldwide. This study serves as a foundational guide for policymakers, academic institutions, and library professionals, offering insights and recommendations that can pave the way for responsible and effective AI integration in academic libraries globally.

7. Implications of the Findings

The study on the adoption and use of artificial intelligence (AI) in academic libraries has significant relevance for both policy and practice within the field of librarianship. For policy, the study reveals the urgent need for strategic frameworks to guide AI integration in libraries, particularly in both developed and developing nations where structured AI roadmaps are often absent. Such policies should focus on fostering national or institutional frameworks that provide a clear vision, ethical guidelines, and designated resources for AI deployment. Policymakers should prioritize the allocation of dedicated budgets for AI infrastructure and staff training, as resource limitations have been identified as a significant barrier to AI adoption. This financial commitment would be especially impactful for libraries in developing nations, where resource constraints are prevalent. Additionally, there is a clear need for policies addressing ethical concerns around AI, such as data privacy, intellectual freedom, and the potential for job displacement. Implementing these policies would involve ethical standards that ensure transparency, protect user data, and safeguard jobs by promoting retraining and skill development for librarians, aligning AI integration with the core values of the library profession.

In practice, the study underscores the importance of capacity-building initiatives to develop AI competencies among librarians. Professional development programs focusing on AI tools and technologies should become a priority, enabling librarians to effectively integrate AI into library operations. Library administrators are encouraged to incorporate AI training into continuous professional development plans, ensuring librarians are not only familiar with AI technologies but can leverage them to enhance services such as cataloging, virtual assistance, and automated indexing. A phased approach to AI implementation is recommended, allowing libraries to tackle initial adoption challenges gradually and refine AI applications based on real-time feedback. Furthermore, collaborations between academic libraries, AI developers, and researchers are vital to create AI solutions tailored to library needs. Through these partnerships, librarians can contribute to AI innovations that address specific operational requirements, leading to the development of AI tools designed with a comprehensive understanding of library contexts.

8. Limitations of the Study

This study, while providing valuable insights, faces certain limitations. The reliance on a content analysis approach limits the study's ability to capture real-time feedback from practitioners, as primary data collection through surveys or interviews was not conducted. Additionally, the study primarily

reviews literature from specific regions, which may not fully reflect the global diversity of AI adoption experiences in academic libraries, particularly those in underrepresented or less-documented areas. Lastly, the study's focus on secondary data may exclude recent advancements or emerging AI applications in libraries, potentially affecting the comprehensiveness of findings on the latest AI trends in librarianship. These limitations suggest the need for future studies incorporating primary data and broader regional representation to enhance understanding of AI adoption in libraries globally.

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